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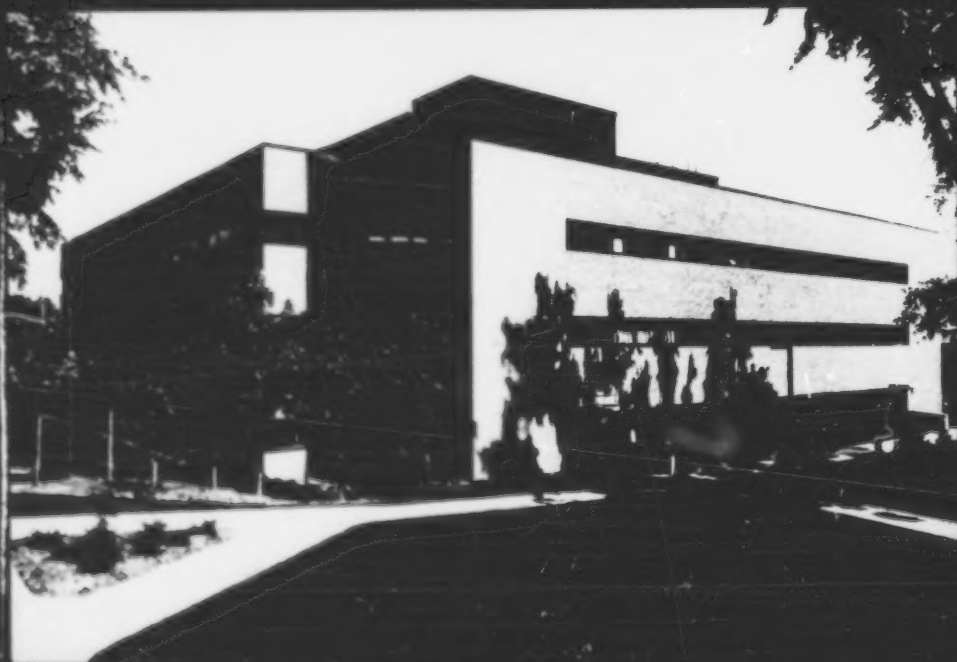
Canadian
Forestry
Service

Service
canadien des
forêts

Program Review

1986~87

Great Lakes Forestry Centre



88-02378/

**PROGRAM REVIEW
GREAT LAKES FORESTRY CENTRE
CANADIAN FORESTRY SERVICE
GOVERNMENT OF CANADA
1986-87**

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THE CANADIAN FORESTRY SERVICE GOVERNMENT OF CANADA

The Canadian Forestry Service (CFS) is the principal source of federal expertise in forestry and has been designated the government's lead agency in forestry matters. Its general objective is to promote the wise management and use of Canada's forest resources for the economic, social, and environmental benefit of Canadians.

The following are the main functions of the CFS:

1. Coordinating federal policies for the promotion of better resource management and development of the forest industry.
2. Providing scientific and technological leadership in forestry through research and development.
3. Providing and analyzing national and international statistics and information as a basis for policy formulation.
4. Developing and certifying codes and standards for the performance of wood products.
5. Protecting Canada's forests from foreign pests.
6. Promoting the eventual use of the forest resource for energy.
7. Contributing to the environmental objectives of the government of Canada.

CFS programs are coordinated with those of other forestry agencies through a variety of mechanisms, including the Canadian Council of Forestry Ministers, the Forest Sector Strategy Committee, management committees for federal-provincial Forestry Development programs, national and regional research advisory committees, and various technical committees for specific program areas.

The CFS consists of a headquarters unit, six forestry centres, and two national institutes. The forestry centres are responsive to regional priorities and maintain close liaison with the respective forestry departments of provincial governments and with other clients. They also participate in, and frequently lead, national programs. The national institutes provide the focus for programs that are national in scope.

SERVICE CANADIEN DES FORÊTS GOUVERNEMENT DU CANADA

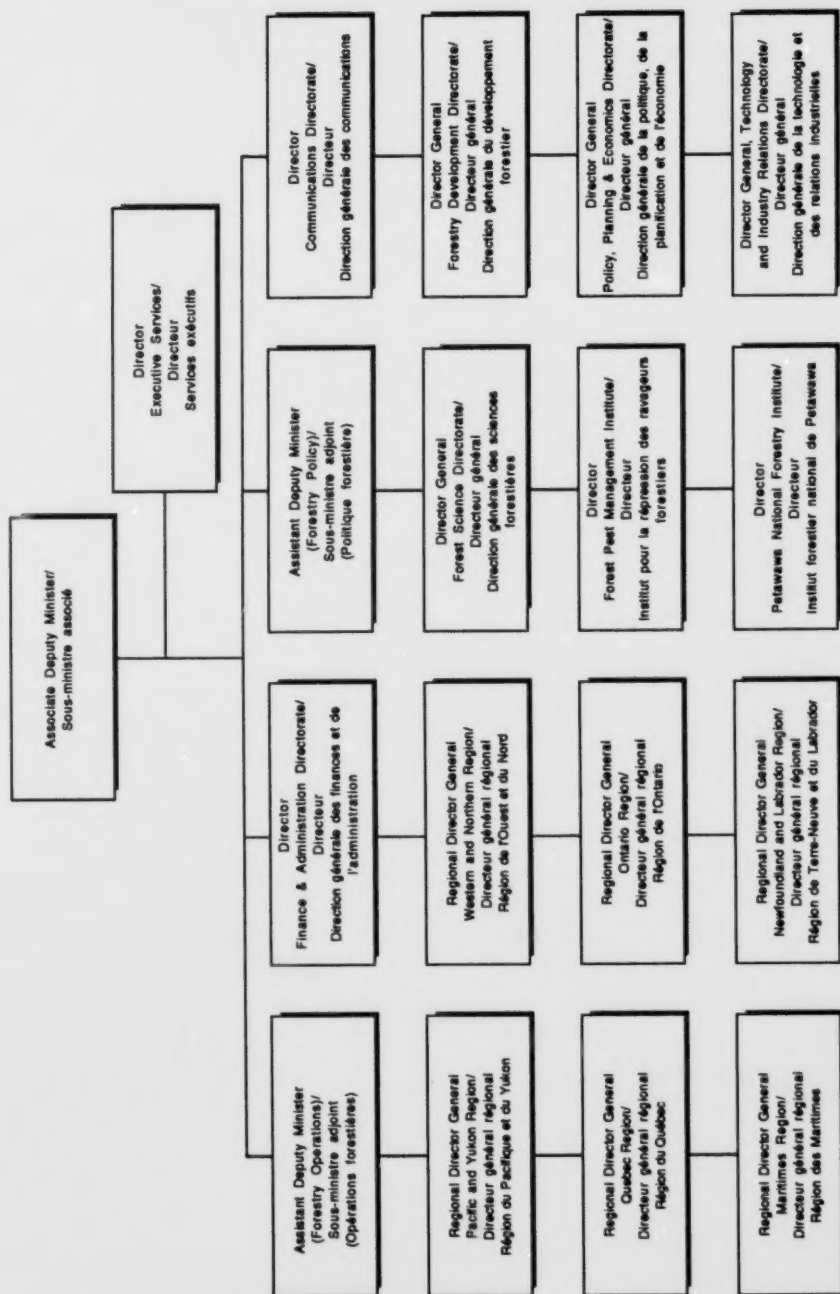
Le Service canadien des forêts (SCF) réunit la majorité des spécialistes fédéraux en foresterie; il a été désigné l'organisme officiel du gouvernement responsable du secteur forestier. Son objectif général est de promouvoir l'aménagement et l'utilisation judicieux des ressources forestières du Canada pour le plus grand bien économique, social et environnemental des Canadiens.

Voici les principales fonctions du SCF:

1. Coordonner les politiques fédérales afin de favoriser l'amélioration de la gestion des ressources et l'expansion de l'industrie forestière.
2. Fournir une orientation scientifique et technologique dans le domaine de la foresterie, par la recherche et le développement.
3. Fournir et analyser les statistiques et l'information nationales et internationales qui serviront à établir les politiques.
4. Mettre au point et homologuer des codes et des normes en matière de rendement des produits du bois.
5. Protéger les forêts canadiennes en luttant contre les ravageurs étrangers.
6. Parrainer l'utilisation éventuelle des ressources forestières pour la production d'énergie.
7. Adhérer aux objectifs environnementaux du gouvernement fédéral.

Les programmes du SCF sont menés de concert avec ceux d'autres organismes forestiers par l'entremise de divers mécanismes dont le Conseil canadien des ministres des Forêts, le Comité de la stratégie forestière, les comités de gestion des programmes fédéraux-provinciaux de développement forestier, les comités techniques axés sur des domaines de programmes spécifiques.

Le SCF comprend une administration centrale, six centres de foresterie et deux instituts nationaux. Les centres de foresterie doivent répondre aux impératifs régionaux et entretenir une liaison étroite avec les ministères provinciaux des Forêts et avec d'autres clients. Ils participent également à des programmes nationaux dont ils assument fréquemment la direction. Les instituts nationaux sont les foyers des programmes d'envergure nationale.





Director General:	J.H. Cayford
Deputy Director General and Program Director, Forestry Development:	R.A. Haig
Program Director, Research and Technical Services:	C.R. Sullivan
Research Manager, Forest Resources:	L.F. Riley
Manager, Planning, Evaluation and Research Services:	G.D. Huntley
Regional Manager, Management Services:	M.J. Parent
Chief, Socio-economic Analysis and Planning:	J.H. Smyth
Chief, Communications Services:	C.A. Plexman
Chief Implementation Officer:	J.J. Farrell (1987)
Technology Transfer Specialist:	G.K.M. Smith (1987)
Information Officer:	D.A. Ortiz
Executive Assistant:	H.M. MacDonald
Management Support Staff:	S.M. Alanen, S.M. Ebling, D.J. Kyostia, G.A. Londry, S.M. Pinder, M.C. Rupprechter



FOREWORD

The Great Lakes Forestry Centre (GLFC) in Sault Ste. Marie, Ontario is one of six regional forestry centres operated by the Canadian Forestry Service (CFS). The CFS provides federal leadership and a national focus in the forestry sector for the continuing economic, social and environmental benefit of Canadians. The main activities of the CFS are research, development and technology transfer, forest resource development through federal-provincial forestry agreements, forest resource data, industry, trade and economics, promotion of the management of federal forest lands, international forestry, human resources planning and public awareness. GLFC is responsible for the CFS program in Ontario.

Two Program Directors are responsible for managing our forestry programs: R.A. Haig (who also serves as Deputy Director General) for Forestry Development, and C.R. Sullivan, for Research and Technical Services. L.F. Riley is Research Manager for Forest Resources and Environmental Forestry, while G.D. Huntley is Manager of Planning, Evaluation and Research Services.

Our research and technical services program includes eight research and two service projects. Research is aimed primarily at maintaining the resource supply by increasing regeneration and reducing losses, but is also directed at increasing utilization and yields per hectare, and maintaining a quality environment. Activities range from basic to applied and developmental research and include a significant element of technology transfer. During the year a technology transfer specialist was appointed.

Major activities in forestry development include the fulfillment of federal management responsibilities for federal-provincial forest management agreements, cooperation with the Canada Employment and Immigration Commission (CEIC) in managing forestry job creation projects, participation in the National Forestry Statistics Program, and provision of expertise in forest economics.

The Ontario Forestry Research Committee (OFRC) was established in 1986 by the Ontario Forestry Council. This committee, with representation from the forest industry, universities, and the federal and provincial governments, will assume responsibilities previously undertaken by the Canada-Ontario Joint Forestry Research Committee (COJFRC), the GLFC Advisory Committee and the Ontario Tree Improvement and Forest Biomass Institute Advisory Committee. The new committee will have responsibility for coordinating all forestry research in the province. During the year the GLFC Advisory Committee

established sub-groups to review programs dealing with forest renewal, stand tending and growth and yield, and provided significant recommendations, which are being implemented where possible.

In June 1986 a two-day workshop was organized by the Domtar Strip-cut Working Group of COJFRC to present the results of major experiments carried out cooperatively by GLFC, the Ontario Ministry of Natural Resources (OMNR) and Domtar Inc. During the year various reports were published, including the proceedings of the 1985 COJFRC Symposium, "Site Classification in Relation to Forest Management", and a handbook on assessment procedures for evaluating silvicultural equipment. Numerous papers were published in the scientific literature and presentations on entomology, pathology, forest fire, atmospheric pollutants, site classification and silviculture were made at several scientific meetings.

During the year the final report of the Forest Management Subsidiary Agreement (FMSA) was completed and an accomplishments report was prepared. Through this \$82 million agreement more than 844 km of forest access road were built or improved, 15 silvicultural camps were constructed, four nursery facilities were expanded, 9,500 ha of forest land were site prepared and 1,800 ha were planted or seeded, a forest ecosystem classification was developed and 23 research projects were undertaken.

A total of \$36 million was expended through the Canada-Ontario Forest Resource Development Agreement (COFRDA). The program included 44,000 ha of site preparation, 21,500 ha of regeneration, 17,600 ha of stand tending and the purchase of 50 million containerized seedlings. An annual report was issued, three copies of the COFRDA newsletter were produced and an interim evaluation was completed.

GLFC cooperated with CEIC in implementing the Job Development Program for the forestry sector. Fifty-eight projects were undertaken involving 602 participants and a total of 14,700 work weeks at a total cost of \$6.3 million.

The \$17.3 million expansion of the GLFC/Forest Pest Management Institute (FPMI) complex was completed. The project involved construction of a major laboratory wing, an administrative addition, renovations to the existing administrative and laboratory complex, and construction of workshop, storage and greenhouse facilities. The official opening of the new facilities was held on 16 May 1986. In attendance were the Hon. Gerald S. Merrithew, then Minister of State (Forestry) and the Hon. James F. Kelleher, then Minister for International Trade.

GLFC cooperated with OMNR through COJFRC in sponsoring the annual symposium, which dealt with modern technology in forest management. GLFC hosted the North Central Forest Insect and Disease Workshop and the Third Northeastern Fire Research Workshop, and organized a forestry study tour for a delegation from the three Lake States. Formal liaison continued with the Faculty of Forestry, University of Toronto, the School of Forestry, Lakehead University and the North Central Forest Experiment Station, United States Forest Service.

During the year, 5-year operational plans were updated for each project and a further draft of the strategic plan was written. Project evaluations were completed for Fire Research and Forest Insect and Disease Survey.

Several personnel changes occurred during the year. I.K. Morrison, who had served as Research Manager, Fire, Pathology and Environmental Forestry, was reassigned as a scientist to the LRTAP project. G.D. Huntley assumed responsibilities as Manager, Planning, Evaluation and Research Services. E.L. Baxter, Chief Engineer, retired; D.W.J. McGowan, Chief Implementation Officer, resigned to accept a position with OMNR and C.E. Dorworth, Research Scientist, Pathology, was transferred to the Pacific Forestry Centre. Staff appointments included J.J. Farrell, Chief Implementation Officer and G.K.M. Smith, Technology Transfer Specialist.

J.H. Cayford
Director General
Great Lakes Forestry Centre
31 March 1987

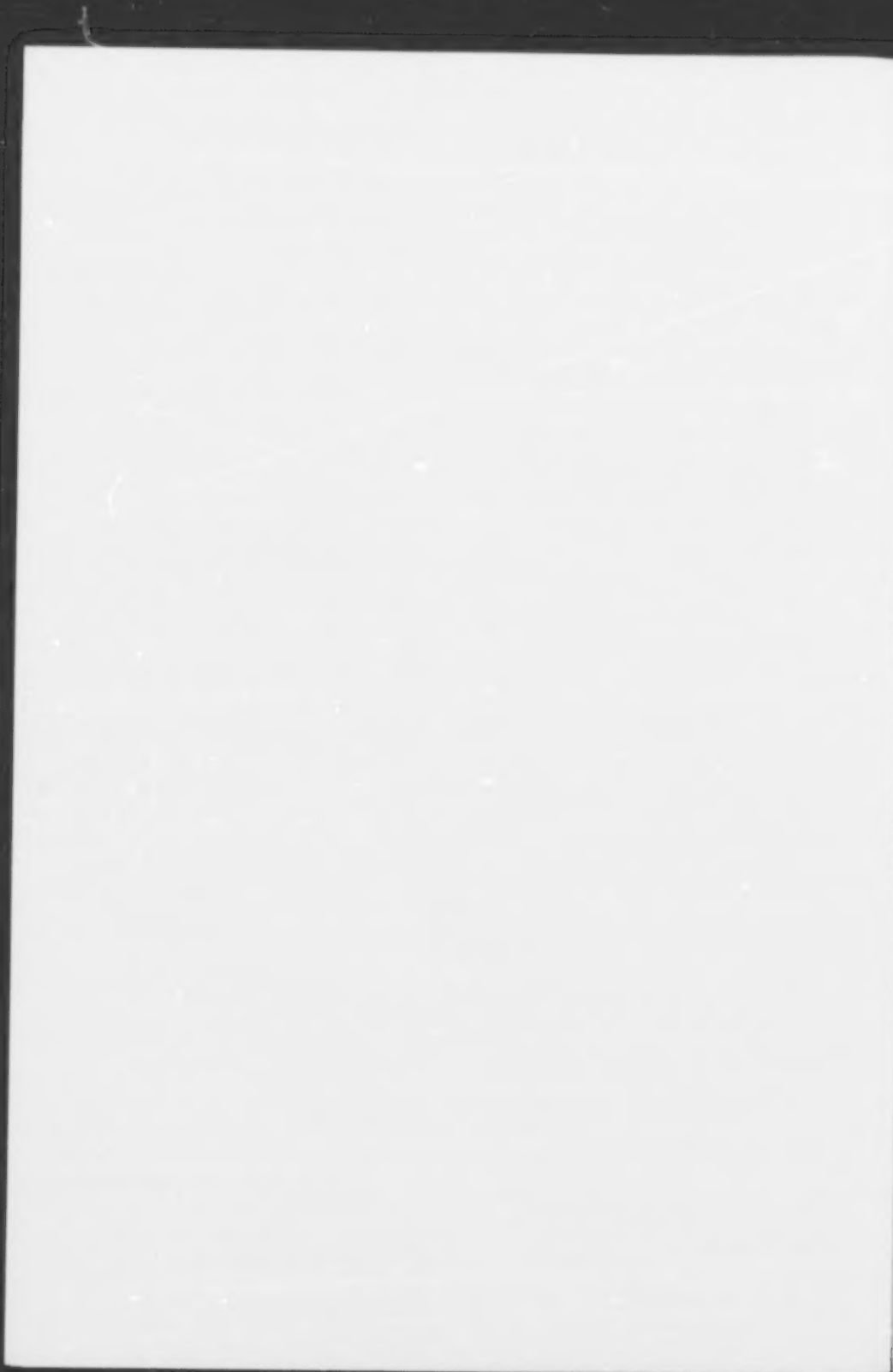


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FOREST ENVIRONMENT RESEARCH



IMPACT OF LONG-RANGE TRANSPORT OF AIR POLLUTANTS ON THE BIOGEOCHEMISTRY OF FOREST ECOSYSTEMS

Professional Staff: N.W. Foster (Project Leader), G.D. Hogan,
I.K. Morrison, J.A. Nicolson, R.D. Whitney

Support Staff: L.M. Chartrand, P.W. Hazlett, R.N. Irwin,
A.W. Johns, D.J. Kurylo, D. Ropke

Objectives

To elucidate the influence of atmospheric deposition of acidifying substances on tree form and function, tree diseases, nutrient cycles and hydrologic processes in Ontario forests.

Achievements

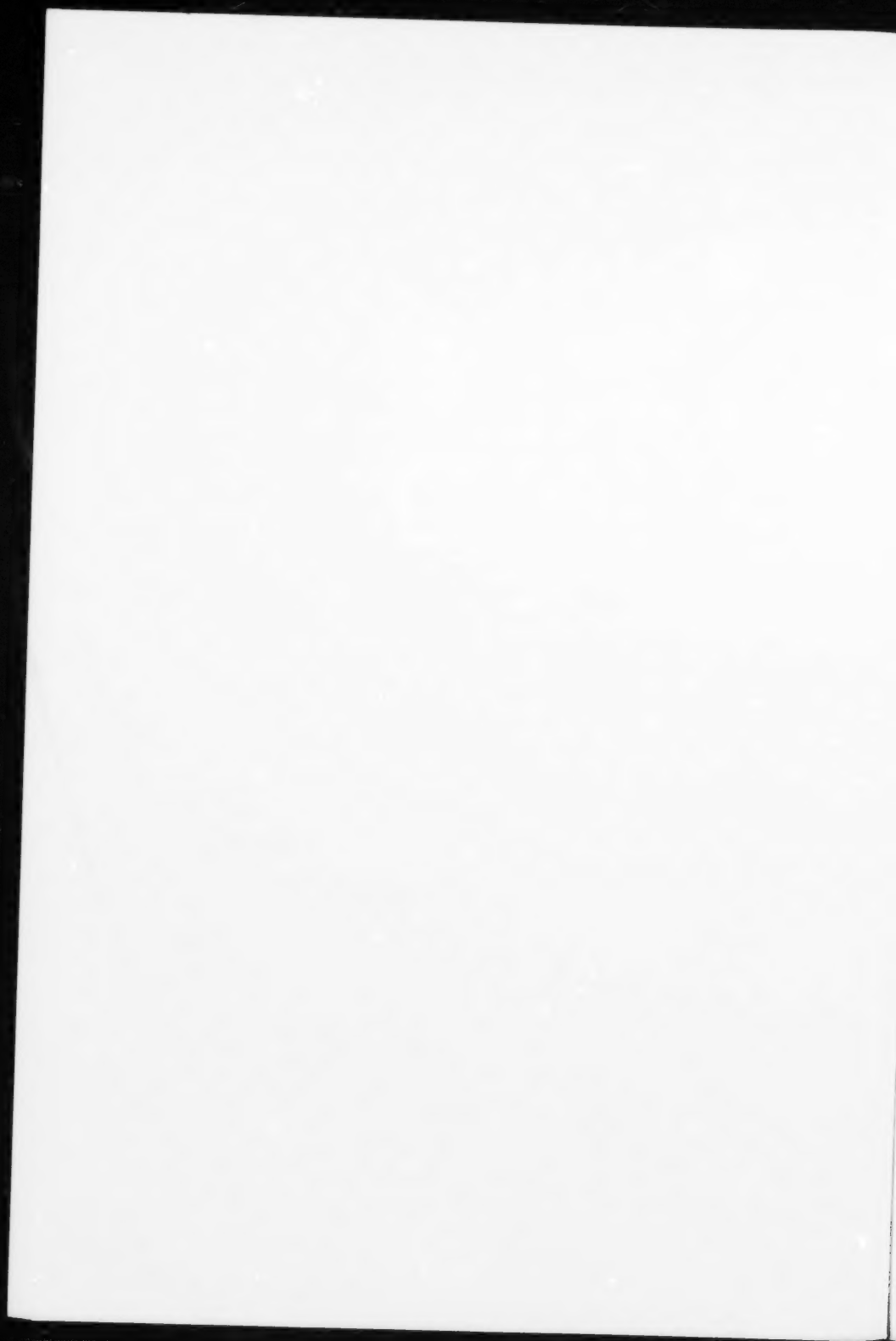
Completed a sixth year of measurement of water quality in 12 terrestrial sub-basins at Turkey Lakes Watershed; determined ion transport through soil at two sites in the watershed; continued field experiments to test the effect of simulated rain of various acidities on Armillaria root rot inoculated in young balsam fir trees; published five journal articles and made five presentations at scientific conferences/workshops.

Goals for 1987-1988

To participate in the Plant-Soil Interactions at Low pH Symposium in Grand Prairie, Alberta, and the International Symposium on Acidification and Water Pathways in Norway; to study and report on ion budgets for terrestrial watersheds, temporal and spatial variation in soil water and streamwater chemistry in the Turkey Lakes Watershed; to carry out growth chamber experiments aimed at determining the morphological and physiological effects of simulated acid rain on native hardwoods; to apply simulated acid rain to trees protected from rain and monitor disease development on Armillaria-inoculated and untreated trees; to quantify the distribution and principal organic pathways associated with the cycle of elements in hardwood forest; to determine the effect of changed acid-base status on leaf-litter decomposition processes.



FOREST PRODUCTION RESEARCH



BLACK SPRUCE ECOSYSTEM SILVICULTURE

Professional Staff: R.A. Sims (Project Leader), R.L. Fleming,
A. Groot, V.F. Haavisto, J.K. Jøglum,
B. Payandeh

Support Staff: M.J. Adams, G.T. Atkinson, G.J. Koteles,
D.S. Mossa, R.M. Siltanen, S.J. Taylor

Objectives

To develop classification systems for forest ecosystem types in Ontario for forest management purposes; to determine if modified cutting and direct seeding are feasible alternatives to clearcutting and planting for regenerating black spruce; to determine the feasibility of intensive treatments such as drainage, thinning and fertilization to increase productivity on black spruce peatlands; to determine the environmental impact of current forest management practices on black spruce ecosystems.

Achievements

As part of the Forest Ecosystem Classification (FEC), completed an operational site classification system for forest management in the Clay Belt; continued a second cooperative FEC study for OMNR's North Central Region; continued analyses and reports on growth and yield data for peatland black spruce and spruce-fir forests; completed a 12-year project on alternate strip clearcutting in shallow-soil upland black spruce, and presented a workshop on all phases of the study; continued investigations of direct seeding on upland and lowland sites, cone and seed production, advance growth on peatlands, and conifer seed treatments to modify germination rates; undertook black spruce spacing and thinning trials and began micro-environmental research on seedbeds; established a cooperative forest drainage experiment with OMNR and began studies on environmental impacts of drainage; continued technology and information transfer related to black spruce management and boreal forestry to foresters and the general public.

Goals for 1987-1988

To analyze and interpret FEC data from the Clay Belt and North Central Region studies, and prepare field manuals on the North Central Region FEC system; to remeasure trials for advance growth and seeding studies; to continue the following: micro-environmental studies of

(continued)

seedbed microsites to improve understanding of seedling growth and survival; black spruce spacing and precommercial thinning trials; environmental studies in lowland forest drainage; work on cone and seed production, conifer seed treatments, growth and yield, boreal forest site classification and peatland forestry; technology and information transfer.

MECHANIZATION OF SILVICULTURE

Professional Staff: C.R. Smith (Unit Head), J-D. Leblanc,
B.J. Sutherland

Support Staff: F.F. Foreman, D.J. Kennington,
J. Richenhaller

Objectives

To develop biologically sound mechanized techniques for the efficient and effective conduct of silvicultural operations in Canada; to develop and maintain contacts in Canada to promote and foster the application of mechanized silvicultural techniques.

Achievements

Published a handbook on standard assessment procedures for evaluating silvicultural equipment; evaluated site preparation with Young's Teeth on sites with dense residual poplars, in cooperation with the University of Toronto; evaluated the potential for precommercial thinning of balsam fir and the economics of precommercial thinning of jack pine; presented at the COJFRC Symposium a paper on current trends in mechanized site preparation technology applicable to Ontario conditions; evaluated the Tetra semi-automatic tree planter, the Great Lakes Forest Products powered scarifier, three disc trenchers in Saskatchewan and a disc trencher and Finnish patch scarifier/moulder in Alberta; with OMNR, provided interim information on seeding of jack pine on prescribed burn sites; published two issues of the Mechanization of Silviculture Newsletter.

Goals for 1987-1988

To establish a follow-up survival and growth trial on areas site prepared with three disc scarifiers in Saskatchewan in 1986; to publish outstanding reports; to undertake an in-depth problem analysis and to outline future project directions.

REFORESTATION SILVICULTURE

Professional Staff: F.W. von Althen (Project Leader),
B. Payandeh, J.B. Scarratt, R.F. Sutton,
J.E. Wood

Support Staff: B.R. Canning, F.W. Curtis, D.L. Marles,
E.G. Mitchell, T.P. Weldon

Objectives

To develop regeneration methods and associated tree-growing techniques for efficient and effective stand establishment and treatment; to develop biologically sound techniques for conducting silvicultural operations in Canada.

Achievements

Published reports on root-growth capacity and field performance of jack pine and black spruce in boreal stand establishment in Ontario, on silvicultural prescriptions for stand establishment, on biological considerations, on nine-year results of a black spruce and white spruce paperpot planting trial in boreal Ontario, on the effectiveness of covering seed spots with plastic shelters, and on factors affecting plantation performance in boreal Ontario; established herbicide trials to generate data in support of the registration of hexazinone on light-textured soils.

Goals for 1987-1988

To complete a detailed problem analysis for reforestation silviculture in Ontario; to prepare a report on timing of initial fertilizer application in container stock; to prepare a report on the use of microcontainers for accelerated transplant production; to prepare a paper entitled "PLANT: A model for artificial forest regeneration in Ontario"; to repeat the application of hexazinone in winter on shearbladed strips to measure response to black spruce planted in the treated strips; to begin field trials with metsulfuron methyl for the control of brush competition on reforestation sites; to organize and conduct a field trip in eastern Ontario to show results of hardwood afforestation studies.

FOREST PROTECTION RESEARCH



FOREST FIRE RESEARCH

Professional Staff: B.J. Stocks (Unit Head), T.J. Lynham,
D.J. McRae

Support Staff: T.W. Blake, G.R. Hartley, J.A. Mason

Objectives

To coordinate GLFC fire research activities as part of Ontario's fire management program and participate in the CFS national program; to develop improved presuppression techniques by means of fuel-specific fire behavior models for major natural and cutover fuel types, by performance analysis and calibration of the Canadian Forest Fire Danger Rating System for Ontario conditions, and by improved fire prediction techniques; to determine the ecological effects of prescribed fire and wildfire on forest ecosystems and relate these to fire behavior parameters.

Achievements

Continued to investigate fire growth from a point-source ignition through experimental burning in immature jack pine; participated in a CFS cooperative experimental burning project in northern Alberta; assisted the People's Republic of China by analyzing its fire weather and fire report data to ascertain the suitability of the Canadian Forest Fire Danger Rating System for China; in conjunction with other CFS fire researchers, continued to work on an improved system for predicting forest fire behavior in Canada; reported on fire behavior in immature jack pine, people-caused fire occurrence in Ontario, fire potential in budworm-damaged forests in Ontario, and crown fire spread rates in immature jack pine.

Goals for 1987-1988

To conduct an expanded program of point-source ignition experimental fires in immature jack pine; to complete analysis and report on the suitability of the Canadian Forest Fire Danger Rating System for use in northeastern China; to continue participation in the CFS national burning project in northern Alberta; to develop a computerized data bank on fuels and fire behavior data on all OMNR operational prescribed burns; to continue participation in the CFS Fire Danger Group and produce an improved Canadian Forest Fire Danger Rating System; to cooperate with American and Canadian atmospheric scientists interested in studying

(continued)

mass-fire behavior of large-scale Ontario prescribed burns forevaluation of the impact of smoke on air quality, and to initiate a cooperative CFS investigation of mass-fire behavior in Ontario; to continue, under a COFRDA contract, a study of fuel loadings and fuel arrangement in natural forest stands in Ontario; to initiate an investigation of the effectiveness of prescribed fire and other site preparation treatments in the Clay Belt Region; to report on fire behavior in mature jack pine, vegetation succession after fire in experimentally burned standing timber fuel types, regeneration success on well documented Ontario wildfires, crown fire propagation in mature and immature jack pine, and the behavior of fires in spruce-lichen woodlands in the Northwest Territories.

DEVELOPMENT AND APPLICATION OF CONCEPTS IN FOREST ENTOMOLOGY IN ONTARIO

Professional Staff: D.R. Wallace (Project Leader),
G.T. Harvey, D.B. Lyons, T.J. Lysyk,
V.G. Nealis, C.J. Sanders

Support Staff: Z.M. Faux, S. Fera, G.S. Lucuik,
D.L. Oliver, P.M. Roden

Objectives

To acquire a sound understanding of the processes involved in regulating insect populations and provide information required by forest managers to cope with pest problems; to develop economically acceptable and environmentally safe methods for limiting forest pests, and to demonstrate the applicability of such methods to forest management in Ontario.

Achievements

Continued the following: field investigations of survival of spruce budworm populations to identify key mortality factors; studies of temperature-dependent development in spruce budworm; dispersal of spruce budworm adults, and the relationship between birds and spruce budworm predation at Black Sturgeon Lake; an isozyme analysis of spruce budworm populations and other forest insects; field testing of sex pheromones for trapping jack pine budworm males; studies of gypsy moth natural control factors, which included the first release of *Ceranthia samarensis*, a European gypsy moth parasitoid; investigations of the effects of meteorological variables on the phenology of the pine false webworm, which included development of predictive models; a taxonomic study of a new species of *Olesicampe* from the pine false webworm; investigation of the phenology of the introduced pine sawfly and its parasitoid complex. Completed the study of methods of sampling for overwintering jack pine budworms and their parasitoids, and the study of instar determination in jack pine budworm; began investigating mortality, especially that caused by *Apanteles* and *Meteorus*, in low-level populations, and began studying the reproductive biology of parasitoids; exchanged insect material with European countries; cooperated in the biological assessment of a release of *Trichogramma minutum* against the spruce budworm.

(continued)

Goals for 1987-1988

To continue the following: investigations of spruce budworm populations with emphasis on further calibration and improvement of sampling methods; studies of spruce budworm adult behavior, including pheromone investigations, field release-recapture tests and cage studies; refinement and validation of models of temperature-dependent development of spruce and jack pine budworms; studies of budworm natural mortality factors, with emphasis on the biology of *Meteorus trachynotus*; studies of the jack pine budworm relating to sampling and mortality factors in collapsing populations; studies of interpopulational variation and interspecific variation in budworms and other forest insects by using isozyme analysis; the delineation of budworm species distribution in the Yukon; the search for more effective spruce and jack pine budworm sex pheromone blends, and determination of the role of components in the disruption of budworm mating. To begin the following: studies of ant predation of spruce budworm; studies of methods of propagating *Trichogramma minutum*; surveys of gypsy moth parasitoids in Ontario; studies of gypsy moth and gypsy moth parasitoid phenology in relation to the introduction of new biological control agents. To expand the search for candidates for biological control of the spruce budworm; to play the lead role in using pheromone trapping for monitoring spruce budworm populations; to make releases of *Ceranthia samarensis* against gypsy moth; to complete studies on the phenology of the pine false webworm and prepare manuscripts for publication.

FOREST PATHOLOGY RESEARCH

Professional Staff: J.T. Basham (Project Leader),
M.T.Dumas, S. Takai, R.D. Whitney

Support Staff: W.E. Britnell, R.N. Irwin, W.C. Richards

Objectives

To develop silvicultural and management procedures and biological control methods to minimize the impact of root rot, stem decay and stem deterioration on the forests of Ontario; to determine relationships between the biology of various stem, butt and root rot causal fungi and different parameters; to correlate disease syndromes of each race of *Ascocalyx abietina*, the cause of Scleroderris cankers, with serotype, and develop control measures for the European race; to exploit past research on *Ceratocystis ulmi* in regulating toxin production and pathogenicity in wilt and dieback diseases.

Achievements

Discovered that all 49 conifer plantations examined in Ontario were sustaining tree mortality caused by *Armillaria* root rot; began host specificity and pathogenicity trials with several isolates of the four biological species of *Armillaria* found in Ontario; discovered the presence of oxalic acid in the culture filtrate and solid medium of all four *Armillaria* species; identified three species of *Trichoderma* found to be inhibitory to major root rot fungi in vitro; published a journal paper on the rate of deterioration of budworm-killed balsam fir stems and its effects on salvage operations; analyzed the impact of the Dutch elm disease toxin cerato-ulmin on elm cell membranes; published information on the specificity of cerato-ulmin production to *Ceratocystis ulmi*.

Goals for 1987-1988

To identify the biotypes of *Pseudomonas fluorescens*, the soil bacterium most inhibitory to root rot fungi; to develop methods of introducing antagonistic microorganisms into the roots and stems of tree seedlings; to conduct host specificity and pathogenicity tests with *Armillaria* spp. in vivo; to publish a journal paper on wood decay and host specificity of *Armillaria* isolates; to complete a booklet and video cassette designed to transfer root rot technology to forest managers and others in Ontario; to publish a journal paper on the effects of scarifying young aspen

(continued)

sucker stands on future tree quality; to study the Dutch elm disease host-pathogen-toxin interrelationships by using immuno-electron microscopic and biochemical approaches; to continue studies of cerato-ulmin biosynthesis at the cellular level; to publish a report on the correlation between cerato-ulmin production and the pathogenicity of *C. ulmi* wild-type isolates.

FOREST UTILIZATION RESEARCH



ENERGY FROM FOREST BIOMASS

Professional Staff: B.J. Sutherland (Project Leader),
J.K. Jeglum

Support Staff: F.F. Foreman

Objectives

To transfer to potential users the technology developed thus far and to study the effects of forest land drainage on peat geochemistry, subsidence and water quality and on the production of biomass from wetlands in northeastern Ontario.

Achievements

Continued a study to monitor the effects of forest land drainage on peat geochemistry, subsidence and water quality and quantity, as part of a larger study to evaluate the effect of drainage on biomass production in Clay Belt wetlands of northeastern Ontario; undertook a cost analysis of producing hog fuel using two systems: the Logging Residue Processor and the Crabe Combine Brush Harvester; completed reports on the following contracts: "The Economics of Integrated Full-tree Harvesting and Central Processing in Jack Pine"; "The Transport of Full Trees Over Public Roads in Eastern Canada"; "An Evaluation of Forest Biomass Compaction Systems in Conjunction with Harvesting and Transportation of Forest Biomass".

Goals for 1987-1988

To transfer to potential users the technology developed thus far; to continue the study on effects of forest land drainage on peat geochemistry, subsidence and water quality and quantity and on the production of biomass from wetlands in northeastern Ontario.



FORESTRY SERVICES

FOREST INSECT AND DISEASE SURVEY

Professional Staff:

G.M. Howse (Unit Head), H.L. Gross,
J.H. Meating, D.T. Myren, K.L. Nystrom,
D.B. Roden, P.D. Syme

Support Staff:

M.J. Applejohn, W.D. Biggs,
H. Brodersen, D.C. Constable,
E.J. Czerwinski, C.N. Davis, H.J. Evans,
C. Handfield, W.A. Ingram, V. Jansons,
A. Johnston, C.G. Jones, A.J. Keizer,
H.D. Lawrence, L.S. MacLeod,
R.K. McCron, S. Payne, R.J. Sajan,
B.E. Smith, M.J. Thomson

Objectives

To provide information on the kind, severity, extent and impact of insect and disease problems in Ontario; to provide forest managers with information needed for decision making on control operations; to advise and assist the province in planning and evaluating control operations; to improve procedures used in insect and disease surveys and assessments; to elucidate the bionomics of little-known forest pests.

Achievements

Conducted aerial and ground surveys of the incidence of, and damage caused by, major forest pests in Ontario, identifying nearly 3,765 insect and 1,400 disease samples and answering about 2,250 inquiries; conducted special surveys of pest problems in plantations, seed orchards, seed production areas, provincial and national parks and high-value commercial timber stands; assessed provincial trials and spraying operations against spruce budworm on 151,000 ha, against jack pine budworm on 482,000 ha and against gypsy moth on 103,000 ha; began or continued studies of the effects of specific insects or diseases on tree health.

Goals for 1987-1988

To conduct annual surveys of, and report on, major forest pest problems in Ontario; to complete the manuscript of Tree Diseases of Eastern Canada; to conduct surveys for pests of white spruce plantations, seeds and cones; to participate in a national early warning system for acid rain by monitoring damage caused in Ontario forests; to assess spraying operations conducted against spruce budworm, jack pine budworm and gypsy moth; to conduct special surveys as required or as opportunities permit.

FOREST SECTOR DATA

Professional Staff: J.H. Smyth (Project Leader)

Support Staff: K.L. Campbell

Objectives

To provide forestry information and related statistical information required by the federal government at both the national and the regional levels in the planning and execution of its national forestry-related obligations and commitments.

Achievements

Completed a report on forest tree production centres in Canada for 1984; updated and maintained a computerized forestry sector statistical base for Ontario; fulfilled GLFC's commitment to convert the Ontario forest resources inventory to national specifications for national reporting under the FORSTATS Program; prepared quarterly reports on selected economic indicators for the Ontario forestry sector; continued work as Chairman of the FORSTATS Committee.

Goals for 1987-1988

To publish a compendium of forestry sector statistics for Ontario; to cooperate with the Canadian Pulp and Paper Association in gathering information for biennial reporting of forest management expenditures in Canada; to update and maintain a forestry sector statistical data base for Ontario; to continue as Chairman of the FORSTATS Committee; to respond to requests for regional information from the public, government agencies, and the forest industry.

LIAISON, DEVELOPMENT AND TECHNICAL SERVICES

Professional Staff: C.R. Smith (Project Leader), J-D. Leblanc,
B.J. Sutherland

Support Staff: F.W. Curtis, F.F. Foreman,
D.J. Kennington, J. Richenhaller

Objectives

To undertake, on behalf of the Centre, activities not directly related to existing forestry or environmental programs; to provide advisory, operational and technical support services to research staff and other agencies.

Achievements

Prepared a revised forest management plan for Canadian Forces Base (CFB) Borden; continued development and maintenance of the GLFC arboretum; maintained jack pine Christmas tree research investigations; provided advisory and technical services to researchers at GLFC; continued operation of the public forest ecology trail.

Goals for 1987-1988

To obtain formal acceptance and approval of the CFB Borden forest management plan and to implement the first-year operating plan; to publish a report on the jack pine Christmas tree provenance trial; to operate the forest ecology trail.

ECONOMIC STUDIES AND DEVELOPMENT

Professional Staff:

J.H. Smyth (Project Leader),
S. Andersen, J.D. Johnson

Support Staff:

A.J. Brownwright, K.L. Campbell

Objectives

To study the economic aspects of forest management and industry issues; to undertake studies in support of departmental issues, to provide input into federal policy initiatives in forest management and forest industry development; to provide an economic perspective in the administration, implementation, and evaluation of federal/provincial forestry agreements; to provide input into program and project evaluation at GLFC and elsewhere in the department; and to provide advisory services to other federal departments, provincial government agencies, and private industry.

Achievements

Completed a draft report on quantification of the impact of spruce budworm on the timber supply of the Dog River-Matawin FMA, northwestern Ontario; completed a report on a comparative study of harvesting and stand establishment costs with alternate strip-cutting and clear-cutting harvesting systems; completed the document "Forestry Perspective '86" for CFS Headquarters; completed a draft report of value-added in the Canadian forestry sector; began a study to analyze the level of softwood lumber exports into the United States from Ontario mills; reviewed proposals submitted under COFRDA; prepared, with OMNR, a framework for interim evaluation of COFRDA.

Goals for 1987-1988

To complete a report on the impact of spruce budworm on the timber supply of the Dog River-Matawin FMA; to complete the report on value added in the Canadian forest industry; to continue to represent GLFC on the CCFRDA Technical Advisory Committee; to participate in the National Forest Economics Program; to represent Canada in the International Energy Agency/Bioenergy Agreement.

FORESTRY DEVELOPMENT



DEVELOPMENT AGREEMENTS

Professional Staff:

J.J. Farrell (Project Leader) (1987),
A.J.F. Ballak, R.M. Greet,
R.L. Macnaughton, H.L. Jääskeläinen,
W.B. Wiltshire

Objectives

To cooperate with OMNR in the administration of Canada-Ontario forestry agreements, and to monitor and record progress and expenditures; to ensure federal visibility in the public relations activities related to Canada-Ontario forestry agreements.

Achievements

Submitted the final annual report on the FMSA to the federal and Ontario ministers; increased activities under COFRDA, with expenditures of about \$36 million, 44,000 ha of site preparation, 21,500 ha of regeneration, 17,600 ha of stand tending, and the purchase of 50 million container seedlings; completed the interim evaluation of COFRDA; revised the Manual of Standards and Procedures; prepared the annual report for 1985-1986; prepared a progress report on the first 2 1/2 years of COFRDA, six news releases, and a report that was published in the Winter 1986 issue of the Forestry Newsletter; published the second issue of the COFRDA Newsletter.

Goals for 1987-1988

To administer COFRDA efficiently, and monitor progress and expenditures accurately; to ensure federal visibility in public information activities related to COFRDA; to begin planning for a new Canada-Ontario agreement to replace COFRDA when it expires.

EMPLOYMENT STIMULATION

Professional Staff:

J.J. Farrell (Project Leader) (1987),
A.J.F. Ballak, R.M. Greet,
R.L. Macnaughton, H.L. Jääskeläinen,
W.B. Wiltshire

Objectives

To provide job opportunities in the forestry sector or assist in their provision, through projects that will enhance the skills of the participants and produce long-term forest management benefits.

Achievements

Cooperated with CEIC in the implementation and administration of the Job Development Program, Forestry Sector, which ended in December 1986, completing 58 projects that provided 14,700 work weeks for 602 participants, and 16,300 training days, for a total expenditure of \$6.3 million; achieved 6,137 ha of inventory, 574 ha of regeneration and 3,818 ha of stand tending; prepared a final report on the program and a report on the productivity of this program and two previous job creation programs.

Goals for 1987-1988

To participate as required in the implementation and administration of any forestry job creation program that may be initiated; to assist CFS Headquarters in the development of forestry labor force statistics for the Ontario Region.

**ADMINISTRATION, FINANCIAL SERVICES AND
PROPERTY MANAGEMENT**



ADMINISTRATION, FINANCIAL SERVICES AND PROPERTY MANAGEMENT

Professional Staff:	M.J. Parent, Regional Manager, Management Services
Support Staff:	T. Ames, C. Bodley, W. Borland, Y. Chartrand, W. Clarke, L. Cormier, D. Evoy, D. Gair, J. Graham, R. Graham, J. Heatley, A. Jones, J. Kimball, J. Lang, C. Lewis, J. Longo, J. Logtenberg, B. MacKay, B. McBain, G. McLeod, M. Mills, R. Moffatt, E. Morningstar, C. Novick, J. Novick, K. Pelletier, M. Pinder, D. Reid, L. Rouse, M. Skouris, D. Sloan, B. Smith, M. Stone, J. Theriault, D. Weeks, A. Zurby

Objectives

To provide administrative, financial and engineering services to GLFC in support of all programs and activities.

Achievements

Completed the following: testing and data entry for the new Materiel Management Information System; an operational survey of all sections, making necessary changes to increase efficiency and decrease costs; a number of construction projects; an engineering review of the operational costs of the physical plant (to be followed by implementation of energy-saving measures); the review of all positions and the updating of all job descriptions in the three areas of responsibility.

Goals for 1987-1988

To modify internal operational activities to meet the requirements of the new MMIS and FMIS systems; to develop the scheduled maintenance program in engineering; to carry out full inventories as well as code all assets with a security code; to review the effectiveness of the engineering work order system and implement changes to improve financial control of this operation; to continue to improve services and reduce costs.

**BIOMETRICS AND APPLIED SOFTWARE SERVICE
AND COMPUTING FACILITIES AND SERVICES**



BIOMETRICS AND APPLIED SOFTWARE SERVICE AND COMPUTING FACILITIES AND SERVICES

Professional Staff: N.I. Bailey, D.W. Beilhartz (Supervisor, Biometrics), J.E. Field (Supervisor, Computing Facilities), I.M-J. Kwain (1986)

Support Staff: D.M. Grave

Objectives

To provide consulting services in experimental design, statistical data analysis, software use and computer applications; to promote the use of automated systems in research, administration and management to improve the efficiency of operations; to provide training in all aspects of computer use; to manage and maintain the in-house computer system.

Achievements

Provided consultation services in software use, computer applications, microcomputer use, experimental design, and statistical data analysis; completed a system for converting OMNR inventory data to a national format (FORSTATS); completed a production version of the fleet management information system and distributed it to other CFS establishments; helped develop and test the Materiel Management Information System; developed models for reporting on COFRDA and for a tool information system for mechanization of silviculture; acquired a computerized graphics system; completed a feasibility study on electronic publishing systems; coordinated staff training on new equipment and provided information sessions; relocated the computer system; acquired and installed a VAX 8500 upgrade; upgraded all DEC software; installed new word processing, communications and integration software.

Goals for 1987-1988

To provide consulting services on the use of available software packages, experimental design, data analysis and statistics; to coordinate installation and development of an in-house electronic publishing system; to assist in automation of library services; to encourage the use of computer terminals and microcomputers by managers and research staff; to provide training in SAS procedures; to develop the use of presentation graphics and graphics for data analysis;

(continued)

to maintain the Materiel Management Information System, the Fleet Management Information System and the COFRDA Management Information System; to complete installation of all supported options on the VAX 8500 computer system; to manage and maintain voice/data communications systems and networks; to plan and maintain computer facilities throughout GLFC.

RESEARCH AND TECHNICAL SUPPORT SERVICES



RESEARCH AND TECHNICAL SUPPORT SERVICES

Staff:

M.F. Laporte (Greenhouse Technician),
J.R. Ramakers (Chemical Analysis
Laboratory Technician), E.R. Rayner
(Photographer)

Objectives

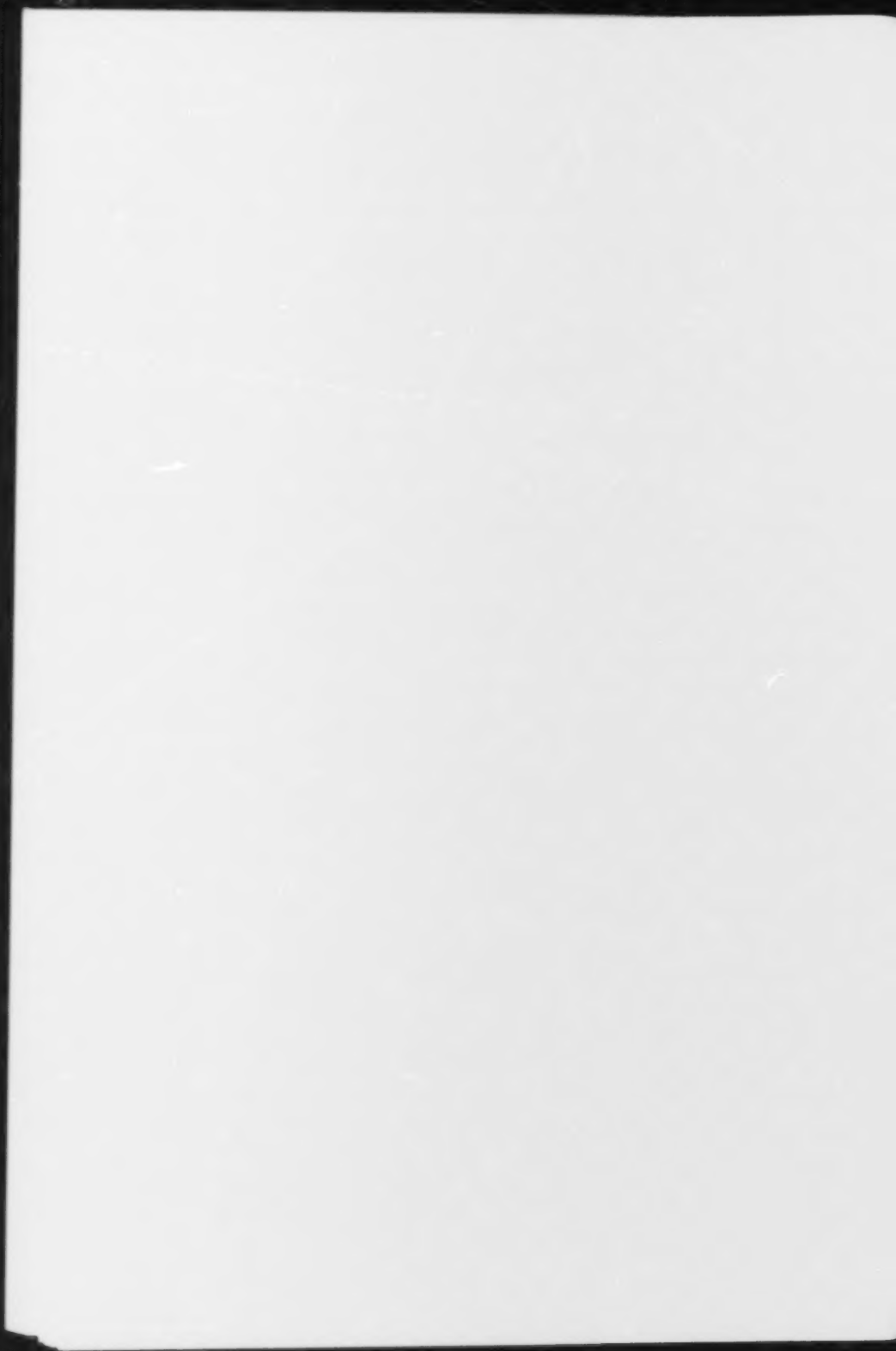
To provide efficient and economical research and technical support services to GLFC.

Achievements

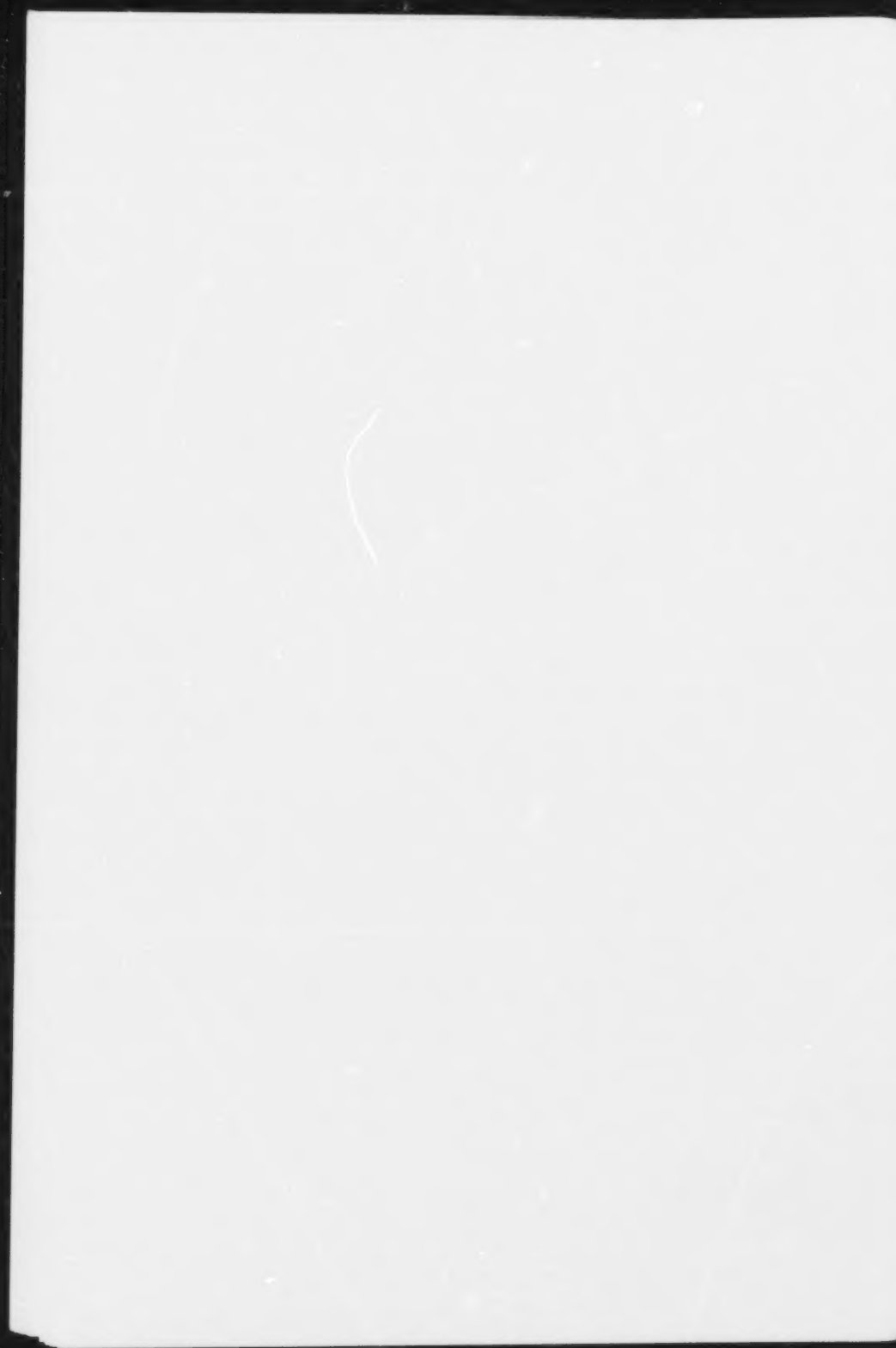
Maintained greenhouse services to meet program needs; performed 32,000 chemical analyses on plant and soil samples; acquired and installed an Inductively Coupled Plasma Emission Spectrometer (ICP); provided photographs, photographic and video services and supplied technical advice for a variety of meetings and the official opening at GLFC; purchased a color processor for the production of custom display prints.

Goals for 1987-1988

To maintain greenhouse services; to improve the pneumatic control system in the seedling production greenhouse; to install personal protection equipment for application of pesticides in greenhouses; to maintain chemical analysis services; to implement new chemistries; to bring the Inductively Coupled Plasma Emission Spectrometry Laboratory on line; to provide photographic and video services.



COMMUNICATIONS SERVICES



COMMUNICATIONS SERVICES

Professional Staff: C.A. Plexman (Chief), S.B. Burt,
D.A. Ortiz (1986)

Support Staff: N.J. Dukes, P. Jakibchuk, D.L. Murphy
(1986); M.K. Rouse, P. Sikorski (1987)

Objectives

To publish and disseminate scientific and technical information issuing from GLFC's research program in response to the needs of provincial and industrial forest managers; to promote an understanding of the wide use of forest resources among the general public; to promote public awareness, appreciation and understanding of Canada's forested environment through personal experience; to cooperate with the provincial government in implementing the communications activities outlined in COFRDA; to promote the research and development activities of GLFC among all sectors of the public; to develop and maintain library services that will meet the changing needs of GLFC and FPMI.

Achievements

Published approximately 100 scientific papers and reports, four issues of the Forestry Newsletter, two issues of the Survey Bulletin and two issues of the Mechanization of Silviculture Newsletter; issued news releases and held news conferences, particularly in connection with the Official Opening of the GLFC extension; held the Official Opening of the extension in May 1986; published "Who's Who at the Great Lakes Forestry Centre 1986" and the 1985-1986 Program Review; investigated the feasibility of introducing an electronic publishing system at GLFC; purchased computerized equipment for the enhancement of graphics in publications, displays and audio-visual presentations; conducted tours of GLFC twice a day from mid-June to the end of August, and made arrangements for tours at other times of the year for special interest groups; completed a new audio-visual program on GLFC's research and development programs; installed additional shelving and work tables in the library; undertook a journal use survey to ensure that the best possible use was made of library resources; updated the serials holding list; worked with other CFS librarians to select an automated library system for the CFS; reorganized library book ordering procedures, ordering directly from Serial Management Systems to reduce ordering time; obtained access to SITE, an on-line serials management data base; installed a new computer terminal and printer in the library.

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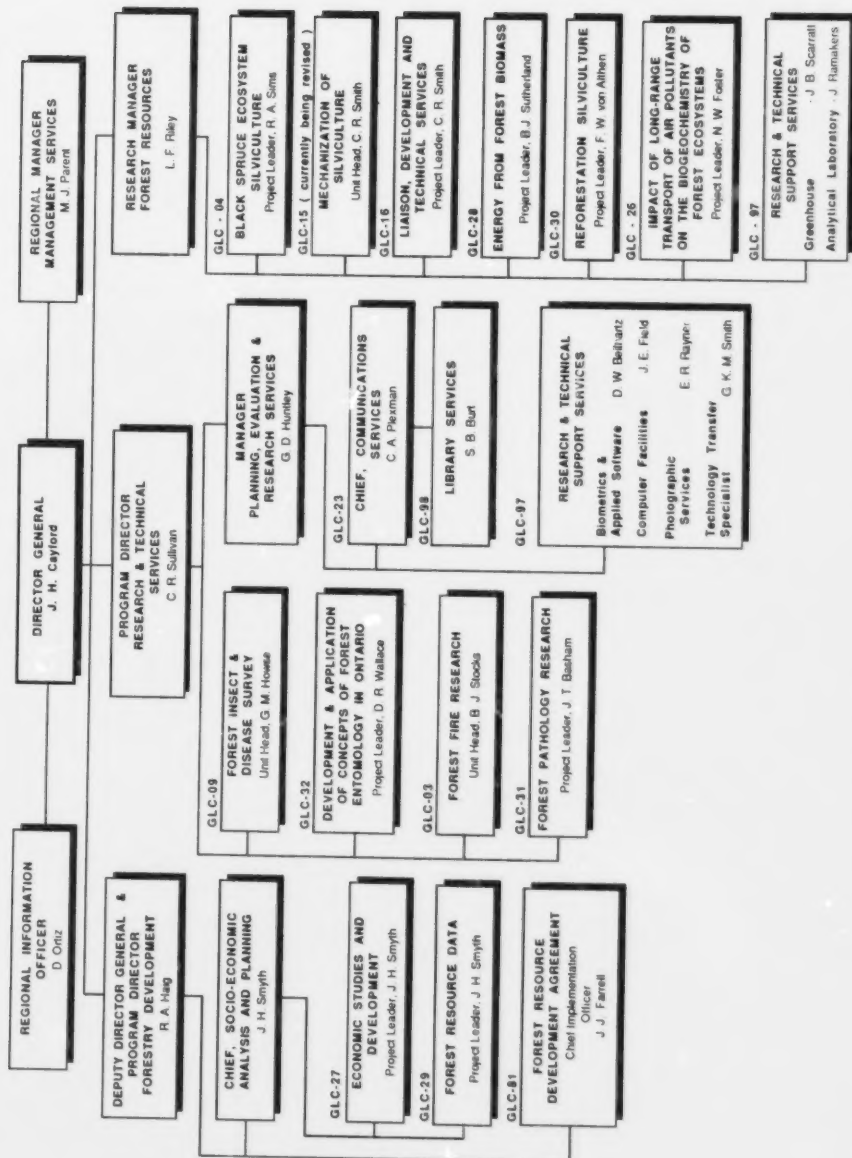
Goals for 1987-1988

To publish and disseminate scientific papers and reports as required, four issues of the Forestry Newsletter, and three issues of the Survey Bulletin; to publish "Who's Who at the Great Lakes Forestry Centre 1987" and the 1986-1987 Program Review; to produce a new booklet outlining the program and activities at GLFC; to publish a bibliography of GLFC publications covering the years 1983-1987; to produce the Proceedings of an annual symposium that will be sponsored henceforth by OFRC; to work on preparations for the 25th anniversary of GLFC; to work with the Forestry Newsletter Advisory Committee to ensure a high-quality newsletter for distribution to the forestry community; to complete arrangements for implementing an electronic publishing system at GLFC, and integrating current graphics systems with it; to install an automated library system compatible with those of other CFS libraries; to acquire a computer work station for the library, as well as VAX-compatible software packages for library use; to promote on-line library services through seminars and demonstrations.

APPENDICES



GREAT LAKES FORESTRY CENTRE PROGRAM ORGANIZATION



EXPENDITURES (\$ '000) - 1986-1987

Project	Person Years	Salaries	Operations and Maintenance	Capital	Grants and Contributions	Operating and Maintenance	Other Total
Forest Environment Research							
Impact of Long-range Transport of Air Pollutants on the Biogeochemistry of Forest Ecosystems	9.3	389.6	120.8	29.5			539.9
Forest Production Research							
Black Spruce Ecosystem Silviculture	11.5	453.0	63.3	115.2			631.5
Mechanization of Silviculture	4.0	157.7	32.5	3.0			193.2
Reforestation Silviculture	10.2	454.3	46.1	17.5			517.9
Forest Protection Research							
Forest Fire Research	6.0	245.4	39.8	10.5			295.7
Forest Pathology Research	8.2	396.8	49.3	15.0			460.9
Development and Application of Concepts in Forest Entomology in Ontario	12.0	498.8	90.0	68.2			677.0
Forest Utilization Research							
Energy from Forest Biomass	0.5	20.5				51.3	71.8
Forestry Services							
Forest Insect and Disease Survey	27.0	1,001.6	148.0	2.4			1,152.0
Forest Resource Data	1.5	62.1	4.4				66.5
Liaison, Development and Technical Services	1.8	65.4	11.9	0.4			77.7

Project	Person Years	Salaries	Operations and Maintenance	Capital	Grants and Contributions	Other Operating and Maintenance	Total
Forestry Development							
Economics Studies and Development	3.5	150.6	12.3				162.9
Forest Resource							
Development Agreement	10.0	338.4	25.0		16,978.0	1,316.7	18,658.1
Employment Stimulation		98.3				24.0	122.3
Management	10.5	483.2	86.2				571.4
Administration, Financial Services and Property Management	39.0	1,106.4	1,285.0	330.1			2,721.5
Communications Services	7.0	203.7	113.5	26.8			344.0
Research Support Services	8.0	271.4	103.9	827.8			1,203.1
TOTALS	170.0	*6,397.0	**2,209.0	1,491.4	16,978.0	1,392.0	28,467.4
*COSEP and COOP students not included							
**PRUF contracts and Unsolicited							
Proposals not included							
		306.6					
		238.5					

**CONTRACTS LET OR SUPERVISED
BY THE GREAT LAKES FORESTRY CENTRE
FOR THE YEAR 1986-1987**

CONTRACTOR	CONTRACT TITLE	VALUE	PAID 1986-1987
A. Jalkanen Jr. Nipigon, Ontario	Assessment of forest harvesting effects upon soil and hydrology parameters in upland black spruce	\$ 3,000	\$ 3,000
ENFOR Project	Productivity improvements in black spruce following drainage	\$ 37,500	\$37,500
ENFOR Project	Economic analysis of producing biomass fuel-wood in Canada using the logging residue processor and the Crane combine brush harvester	\$ 15,000	\$15,000
New Brunswick Research	Jack pine budworm pheromone and Productivity Council	\$ 5,000	\$ 5,000
Biocontrol Laboratory University of Guelph	Trichogramma material for release trials	\$ 8,000	\$ 8,000

**CANADA-ONTARIO FOREST RESOURCE
DEVELOPMENT AGREEMENT CONTRACTS**

Horton Forestry Services Toronto, Ontario COFRDA Project	Examination of stand structure and development in second-growth black spruce forests	\$144,134	\$63,245
M. Browning Toronto, Ontario	Mycothiza development in container seedlings	\$214,038	\$46,890
Hunter and Associates Mississauga, Ontario	Fuel complex quantifications in natural forest stands	\$187,700	\$10,368
E.B. Dumbroff University of Waterloo COFRDA Project	Drought tolerance and physiological mechanisms of resistance in northern coniferous seedlings	\$ 83,485	\$43,175
ABL Forest Science Inc. COFRDA Project	Investigate planting stock quality and study the adaptation of conifer seedlings to site	\$153,123	\$63,141
Matcam Forestry Consultants Sault Ste. Marie, Ontario	Direct seeding of black spruce on upland sites in NW Ontario (several contracts)	\$183,400	\$51,683

CONTRACTOR	CONTRACT TITLE	VALUE	PAID 1986-1987
D.N. Ray University of Toronto COFRDA Project	Chemical characterization of jack pine as a contribution to developing greater selection criteria for improving fiber utilization (several contracts)	\$ 87,333	\$24,147
D.L. Merell University of Toronto	The impact of fire on timber supply	\$134,917	\$22,002
P.C. Luzzani University of Toronto COFRDA Project	Collating soil nutrient standards for seed orchard management	\$163,205	\$40,213
Ndm Forestry Consultants Thunder Bay, Ontario COFRDA Project	Investigate the effects of microsite compaction on direct seeding success of jack pine and black spruce in northwestern Ontario	\$ 46,621	\$28,689
R. Krutzfelder University of Guelph COFRDA Project	Factors influencing integrated forest management on private industrial forest land	\$ 6,817	\$ 5,232
A.M. Gordon University of Guelph COFRDA Project	Post-harvesting silvicultural techniques to enhance white pine and red oak components in shelter-site forests in central Ontario	\$ 45,687	\$13,378
G. Hofstra University of Guelph	Reducing drought and temperature stress in conifer seedlings with stress-inhibiting compounds	\$ 99,782	\$26,493
G. John Barry Sault Ste. Marie, Ontario	Effects of forest drainage on the hydrology of black spruce swamps and low ground sites	\$134,139	\$ 5,695
R.S. Jang University of Toronto	Mechanisms of simulatory effect of lipoic acid on synchrotron formation in <i>O. alba</i>	\$150,366	\$52,807
Pac-Vision Communications Group Inc., Toronto, Ont.	Transfer of rust rot technology	\$ 93,814	\$40,024
E.S. Eddy Forest Products Esperanza, Ontario COFRDA Project	Design and implementation of plantation establishment trial for lamarck, with particular emphasis on site selection, planting stock and herbicide application	\$107,332	\$12,332
C. Nozotte University of Ottawa	Seed development in jack pine	\$ 56,240	\$25,229
Matern Forestry Consultants Sault Ste. Marie, Ontario	Fire protection in intensively managed plantations	\$142,287	\$27,186

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CONTRACTOR	CONTRACT TITLE	VALUE	PAID 1986-1987
R.E. Farmer Lakehead University COFRDA Project	Development of short-rotation silvicultural systems for selected poplar and larch in northwestern Ontario	\$159,270	\$37,828
Hunter and Associates Mississauga, Ontario	Research component, NC region forest ecosystem	\$127,584	\$59,534
V. Squires Sault Ste. Marie, Ontario	Estimating buffers for VLV and ULV glyphosate applications for conifer release	\$49,679	\$ 0
R.A. Fletcher/G. Hofstra University of Guelph Guelph, Ontario	Management of phytotoxicity of sub-lethal glyphosate deposits on selected forest and riparian weed species	\$ 50,214	\$ 0
R.J. Day Lakehead University COFRDA Project	Establishment and early growth of black spruce in relation to seedling physiology and time of outplanting	\$ 67,488	\$25,663
E. van Eerden Victoria, B.C. COFRDA Project	Cold storage of coniferous containerized planting stock	\$ 13,775	\$13,375
kbm Forestry Consultants Thunder Bay, Ontario COFRDA Project	Fifth-year assessment and growth analysis of <i>P. banksiana</i> and <i>P. mariana</i> on simulated Bracke mounds	\$ 19,159	\$18,426
Ecological Services for Planning Limited Timmins, Ontario COFRDA Project	Timing and impacts of aerial herbicide spraying in black spruce in the Clay Belt	\$102,921	\$29,141
S. Pale, Ontario Centre for Remote Sensing Toronto, Ontario	Development of operational regeneration assessment methodology based on high- resolution satellite data	\$123,371	\$38,371

PUBLICATIONS

- Albini, F.A. and STOCKS, B.J. 1986. Predicted and observed rates of spread of crown fires in immature jack pine. *Combust. Sci. and Tech.* 48:65-76.
- ANON. 1986a. Program Review Great Lakes Forestry Centre 1985-86. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. 63 p.
- ANON. 1986b. Who's Who at the Great Lakes Forestry Centre 1986. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont.
- Armson, K.A. 1986. Opening remarks. p. 1-2 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- Barnes, B.V. 1986. Varieties in experience in classifying and mapping forest-land ecosystems. p. 5-23 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- Burron, D.E., SMYTH, J.H., CAMPBELL, K.L. and Martel, J-P. 1986. Forest management expenditures in Canada, 1977-1983. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Joint Rep. No. 9 and Inf. Rep. W.S. Index 2992 (bi.) (F-11) (Canadian Pulp and Paper Association). 85 p. (aussi disponible en français sous le titre "Depenses en aménagement forestier au Canada, 1977-1983").
- BIGGS, W.D. and PAYNE, S.G. 1986. Results of forest insect and disease surveys in the North Central Region of Ontario, 1985. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 37. 34 p.
- BRODERSEN, H. and EVANS, H.J. 1986. Results of forest insect and disease surveys in the Southwestern Region of Ontario, 1985. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 42. 25 p.
- Carmean, W.H. 1986. Forest site quality research in the North Central Region. p. 62-67 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.

- CAYFORD, J.H. 1986. Historical highlights 1958-1983 Canadian Institute of Forestry. *For. Chron.* 62(4):255-261.
- CAYFORD, J.H. and SULLIVAN, C.R. 1986. Evaluating scientists in Canada. p. 107-110 in Denver, P. Burns, *Comp. Proceedings IUFRO: Evaluation and planning of forestry research. Internat'l. Union For. Res. Org. (S6.06-St.06.01)*, Fort Collins, Colo., 25-26 July 1985. USDA For. Serv., Northeast. For. Exp. Stn., NE-CTR-111, Broomall, Penn. 156 p.
- CONSTABLE, D.C. and JANSONS, V. 1986. Results of forest insect and disease surveys in the Northwestern Region of Ontario, 1985. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 36. 32 p.
- Corns, I.G.W. and Annas, R.M. 1986. Ecological classification of Alberta forests and its application in forest management. p. 53-61 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.*
- EVANS, H.J., SAJAN, R.J. and BRODERSEN, H. 1985. Results of forest insect and disease surveys in the Central Region of Ontario, 1985. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 41. 35 p.
- FLEMING, R.L. and HAAVISTO, V.F. 1986. A case for improving the efficiency of seed extraction from black spruce (*Picea mariana* [Mill.] B.S.P.) cones. *Tree Plant. Notes* 37(4):7-11.
- FOSTER, N.W. and Beauchamp, E.G. 1986. Nitrogen release from urea and sulfur coated urea in jack pine forest humus. *Soil Sci. Soc. Am. J.* 50(1):226-229.
- FOSTER, N.W., MORRISON, I.K. and Swan, H.S.D. 1986. Growth response of a boreal black spruce stand to fertilizer treatments. *North. J. Appl. For.* 3:142-144.
- GREET, R. 1986. Forestry enters the age of technology. p. 4-5 in C.A. PLEXMAN, *Ed. Forestry Newsletter. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Winter issue.*
- GROOT, A. 1985. Application of germination inhibitors in organic solvents to conifer seeds. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. *Inf. Rep. O-X-371.* 14 p.

- HAIG, R.A. 1986. Federal/provincial forestry agreements chalk up major achievements. p. 6 in C.A. PLEXMAN, Ed. Forestry Newsletter. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Summer issue.
- HARVEY, G.T. 1985a. Egg weight as a factor in the overwintering survival of spruce budworm (Lepidoptera: Tortricidae) larvae. Can. Ent. 117(12):1451-1461.
- HARVEY, G.T. 1985b. Second diapause in the population dynamics of spruce budworms. p. 112 in C.J. SANDERS, R.W. Stark, E.J. Mullins and J. Murphy, Ed. Recent advances in spruce budworms research. Proc. CANUSA Spruce Budworms Research Symposium, Bangor, ME., 16-20 Sept. 1984.
- HARVEY, G.T. 1985c. The taxonomy of the coniferophagous *Choristoneura* (Lepidoptera: Tortricidae): a review. P. 16-48 in C.J. SANDERS, R.W. Stark, E.J. Mullins and J. Murphy, Ed. Recent advances in spruce budworms research. Proc. CANUSA Spruce Budworms Research Symposium, Bangor, ME., 16-20 Sept. 1984.
- Heikurinen, J.K. and Kershaw, H.M. 1986a. Forest soils as a management framework: the application. p. 104-112 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- Heikurinen, J.K. and Kershaw, H.M. 1986b. Forest soils as a management frame work: the data base. p. 95-103 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- Holland, W.D. 1986. Ecological land classification in Banff and Jasper national parks. p. 38-44 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- HOWSE, G.M. 1986. Forest insect problems in Ontario. p. 9-10 in C.A. PLEXMAN, Ed. Forestry Newsletter. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Summer issue.
- HOWSE, G.M. and APPLEJOHN, M.J. 1986. Forest insect and disease conditions in Ontario, 1986. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Survey Bulletin. Spring, Summer, Fall.

- INGRAM, W. 1986. Results of forest insect and disease surveys in the Eastern Region of Ontario, 1985. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 43. 33 p.
- JEGLUM, J.K. 1986a. Observations on peatland forestry in Finland. p. 208-237 in Proc. Symposium '85: A Technical and Scientific Conference on Peat and Peatlands. Riviere-du-Loup, Quebec, 16-20 June 1985.
- JEGLUM, J.K. 1986b. Strip-cutting workshop held at Nipigon. p. 3-4 in C.A. PLEXMAN, Ed. Forestry Newsletter. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Winter issue.
- JEGLUM, J.K. 1986c. Workshop sparks interest among forest drainage experts. p. 7 in C.A. PLEXMAN, Ed. Forestry Newsletter. Gov't of Can., CLASSIFICATION IN LAND-USE PLANNING. P. 118-120 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- Jones, R.K. 1986. Soil survey and its use in forest management in Ontario. p. 29-37 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- Kenrick, J. 1986. Site classification in land-use planning. p. 118-120 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- MacInnes, C.D. and Voigt, D.R. 1986. Wildlife reaction to forest sites. p. 121-131 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- MacLEOD, L.S., JONES, C.G. and KEIZER, A.J. 1986. Results of forest insect and disease surveys in the Northern Region of Ontario, 1985. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 38. 45 p.

- MACNAUGHTON, R.L., *Comp.* 1986. Unemployment Insurance/Job Creation Program - Forestry Sector in Ontario. Final Report. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 44. 21 p. + appendices.
- McColm, R.G. 1986. Forest site classification in the Northern Region 1985. p. 89-91 in G.M. WICKWARE, and W.C. Stevens *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- McRAE, D.J. 1986. Prescribed burning for stand conversion in budworm-killed balsam fir: an Ontario case history. *For. Chron.* 62(2):96-100.
- McVey, C.G. and Evers, R.W. 1986. Intensive soil survey procedures in the fast growing hardwoods program. p. 68-71 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- MEATING, J.H., HOWSE, G.M., SYME, P.D. and SMITH, K.L. 1985. Spruce budworm parasitoid surveys in Ontario. p. 105-106 in C.J. SANDERS, R.W. Stark, E.J. Mullins, and J. Murphy, *Ed.* Recent advances in spruce budworms research. Proc. CANUSA Spruce Budworms Research Symposium, Bangor, ME., 16-20 Sept. 1984.
- MORRISON, I.K. and FOSTER, N.W. 1986. Effects of acid deposition on nutrient cycling in northern hardwood forests. p. 139-155 in G.D. Mroz and D.D. Reed, *Comp.* Proc. of a Conf. on the Northern Hardwood Resource: Management and Potential. 18-20 Aug. 1986. Mich. Tech. Univ., Houghton.
- MORRISON, I.K. and HOGAN, G.D. 1986. Trace element distribution within the tree phytomass and forest floor of a tolerant hardwood stand, Algoma, Ontario. *Water, Air and Soil Pollut.* 31:493-500.
- MYREN, D.T., and DORWORTH, E.B. 1986. Names and authors used for fungi at the Great Lakes Forestry Centre. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Inf. Rep. O-X-376. 42 p. + Appendix.

- NEALIS, V.G. 1986. Response to host kairomones and foraging behavior on the insect parasite *Cotesia rubecula* (Hymenoptera: Braconidae). *Can. J. Zool.* 64:2393-2398.
- NEALIS, V.G. and Régnière, J. 1987. The influence of parasitism by *Apanteles fumiferanae* Vier. (Hymenoptera: Braconidae) on spring dispersal and changes in the distribution of larvae of the spruce budworm (Lepidoptera: Tortricidae). *Can. Ent.* 119:141-146.
- NICOLSON, J.A. 1984. Ion concentrations in precipitation and streamwater in an Algoma maple-birch forest. p. 125-135 in *Proc. Can. Hydrol. Symp. No. 15 - 1984. Water Quality Evolution within the Hydrological Cycle of Watersheds. Vol. 1*, Univ. Laval, Quebec. Nat'l Res. Council. Can., Assoc. Comm. Hydrol., NRCC No. 24633.
- ORTIZ, F. 1986. Job creation in the forestry sector of Ontario. p. 7-9 in C.A. PLEXMAN, Ed. *Forestry Newsletter*. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Winter issue.
- PAYANDEH, B. 1985. A simulation model for the economic evaluation of forest regeneration systems. p. 46-55 in *The yield advantages of artificial regeneration at high latitudes. Proc. Sixth Internat'l. Workshop on For. Regen., Edmunston, N.B. 10-11 Aug. 1984.*
- PAYANDEH, B. 1986. Predictability of site index from soil factors and lesser vegetation in northern Ontario forest types. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Inf. Rep. O-X-373. 12 p. + appendices.
- PAYANDEH, B. and FIELD, J.E. 1986. Yield functions and tables for mixedwood stands of northwestern Ontario. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Inf. Rep. O-X-375. 7 p. + appendices.
- Pierpoint, G. 1986. An orientation to site classification in Ontario. p. 24-28 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- PLEXMAN, C.A. 1985. Supplement to bibliography of Great Lakes Forest Research Centre publications. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. 23 p. + Appendix.

- PLEXMAN, C.A., *Ed.* 1986. Forestry Newsletter. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Spring, Summer, Fall, Winter.
- Puttock, G.D. and SMITH, C.R. 1986. An evaluation of site preparation with the Donaren 18D Powered Disc Trencher on full-tree logged sites. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Inf. Rep. O-X-372. 24 p. + appendices. (aussi disponible en français sous le titre "Evaluation de la préparation du sol de stations soumises à la récolte des arbres entiers, au moyen du planteur [scarificateur] à disques hydraulique Donaren 180D").
- REGNIERE, J. 1985. Interpreting historical records. p. 143-144 in C.J. SANDERS, R.W. Stark, E.J. Mullins, and J. Murphy, *Ed.* Recent advances in spruce budworms research. Proc. CANUSA Spruce Budworms Research Symposium, Bangor, ME., 16-20 Sept. 1984.
- RILEY, L.F. 1986. Cooperative projects with FERIC. p. 13 in C.A. PLEXMAN, *Ed.* Forestry Newsletter. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Spring issue.
- SAJAN, R.J. and SMITH, B.E. 1986. Results of forest insect and disease surveys in the Algonquin Region of Ontario, 1985. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 40. 45 p.
- SANDERS, C.J. 1985a. Disruption of spruce budworm mating by sex pheromone. p. 397 in C.J. SANDERS, R.W. Stark, E.J. Mullins, and J. Murphy, *Ed.* Recent advances in spruce budworms research. Proc. CANUSA Spruce Budworms Research Symposium, Bangor, ME., 16-20 Sept. 1984.
- SANDERS, C.J. 1985b. Effects of bird exclusion on budworm populations in northwestern Ontario. p. 94 in C.J. SANDERS, R.W. Stark, E.J. Mullins, and J. Murphy, *Ed.* Recent advances in spruce budworms research. Proc. CANUSA Spruce Budworms Research Symposium, Bangor, ME., 16-20 Sept. 1984.
- SANDERS, C.J. 1985c. Sex pheromone as a trigger of female moth dispersal. p. 113-114 in C.J. SANDERS, R.W. Stark, E.J. Mullins, and J. Murphy, *Ed.* Recent advances in spruce budworms research. Proc. CANUSA Spruce Budworms Research Symposium, Bangor, ME., 16-20 Sept. 1984.

- SANDERS, C.J. 1985d. Sex pheromone traps for monitoring spruce budworm populations. p. 234 in C.J. SANDERS, R.W. Stark, E.J. Mullins and J. Murphy, *Ed.* *Recent advances in spruce budworms research.* Proc. CANUSA Spruce Budworms Research Symposium, Bangor, ME., 16-20 Sept. 1984.
- SANDERS, C.J. 1985e. Summary. p. 145 in C.J. SANDERS, R.W. Stark, E.J. Mullins, and J. Murphy, *Ed.* *Recent advances in spruce budworms research.* Proc. CANUSA Spruce Budworms Research Symposium, Bangor, ME., 16-20 Sept. 1984.
- SANDERS, C.J. 1986. Evaluation of high-capacity, nonsaturating sex pheromone traps for monitoring population densities of spruce budworm (Lepidoptera: Tortricidae). *Can. Ent.* 118:611-619.
- SANDERS, C.J. and LUCUIK, G.S. 1985. Effect of weather on spruce budworm populations. p. 90-91 in C.J. SANDERS, R.W. Stark, E.J. Mullins, and J. Murphy, *Ed.* *Recent advances in spruce budworms research.* Proc. CANUSA Spruce Budworms Research Symposium, Bangor, ME., 16-20 Sept. 1984.
- SCARRATT, J.B. 1985a. Containerized seedling production statistics for Ontario, 1984. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Joint Rep. No. 7. 19 p. (published under the auspices of the Container Stock Working Group of the Canada-Ontario Joint Forestry Research Committee).
- SCARRATT, J.B. 1985b. Containerized seedling production statistics for Ontario, 1983. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Joint Rep. No. 8. 23 p. (published under the auspices of the Container Stock Working Group of the Canada-Ontario Joint Forestry Research Committee).
- SCARRATT, J.B. 1986. An evaluation of some commercial soluble fertilizers for culture of jack pine container stock. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Inf. Rep. O-X-377. 21 p. + appendices.
- SIMS, R.A. 1986. Developing a forest ecosystem classification for the North Central Region of Ontario. p. 101-113 in H. van Groenewoud, *Comp.* Forest site classification methods. Proc. Workshop IUFRO Working Party on Site Classification and Evaluation, Fredericton, N.B.

- SIMS, R.A., Towill, W.D. and WICKWARE, G.M. 1986. A status report on a forest ecosystem classification (FEC) program for Ontario's North Central Region. p. 72-82 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- SIPPELL, W.L. 1985. Historical records suggest a new international strategy of management for the spruce budworm in North America. p. 140-142 in C.J. SANDERS, R.W. Stark, E.J. Mullins, and J. Murphy, *Ed.* Recent advances in spruce budworms research. Proc. CANUSA Spruce Budworms Research Symposium, Bangor, ME., 16-20 Sept. 1984.
- SMITH, C.R., JOHNSON, J.D., and RILEY, L.F. 1985. Economics of precommercial thinning in jack pine. p. 34-45 in The yield advantages of artificial regeneration at high latitudes. Proc. Sixth Internat'l. Workshop on For. Regen., Edmunston, N.B. 10-11 Aug. 1984.
- Stanclik, G.E. 1986. The use of site classification by Abitibi-Price Inc. in the Iroquois Falls forest. p. 83-87 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- STOCKS, B.J. 1985. Forest fire behavior in spruce budworm-killed balsam fir. p. 188-199 in C.J. SANDERS, R.W. Stark, E.J. Mullins, and J. Murphy, *Ed.* Recent advances in spruce budworms research. Proc. CANUSA Spruce Budworms Research Symposium, Bangor, ME., 16-20 Sept. 1984.
- STOCKS, B.J. 1987. Fire potential in the spruce budworm-damaged forests of Ontario. *For. Chron.* 63:8-14.
- SUTHERLAND, B.J. 1986. Standard assessment procedures for evaluating silvicultural equipment: a handbook. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. 96 p. + appendices, illus.
- SUTTON, R.F. 1986. Hexazinone GridballsTM applied with concurrent underplanting of white spruce in boreal mixedwoods: 7-year results. *For. Chron.* 62(4):226-232.

- Taylor, E.P. 1986. Soil interpretation and training program for the Central and Southwestern regions 1980-1985. p. 135-142 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- Teskey, S.B. 1986. Economics of site evaluation: Northeastern Region economic prime sites model. p. 113-117 in G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14.
- THOMSON, M.J., CONSTABLE, D.C., EVANS, H.J., INGRAM, W.A. and MacLEOD, L.S. 1985. A review of important insect and disease problems in the Atikokan District of Ontario, 1950-1980. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 29. 100 p + appendices.
- THOMSON, M.J., CZERWINSKI, E.J., MacLEOD, L.S., and PAYNE, S.G. 1986. Results of forest insect and disease surveys in the Northeastern Region of Ontario, 1985. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 39. 49 p.
- THOMSON, M.J., EVANS, H.J., CONSTABLE, D.C., JONES, C.G. AND MacLEOD, L.S. 1986. A review of important forest insect and disease problems in the Terrace Bay District of Ontario, 1950-1980. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 47. 74 p. + appendices.
- THOMSON, M.J., MacLEOD, L.S., EVANS, H.J., CONSTABLE, D.C. and JONES, C.G. 1986. A review of important insect and disease problems in the Geraldton District of Ontario, 1950-1980. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 46. 102 p. + appendices.
- von ALTHEN, F.W. 1986. Effects of planting date on outplant performance of cold-stored and fresh-lifted black walnut, red oak and silver maple seedlings. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Inf. Rep. O-X-374. 9 p.
- von ALTHEN, F.W. and Prince, F.A. 1986. Black walnut (*Juglans nigra* L.) establishment: six-year survival and growth of containerized and 1+0 seedlings. Tree Plant. Notes 37(1):11-14.

- WALLACE, D.R. 1986. *Trichogramma* versus spruce budworm. A cooperative project in Ontario. p. 3-6 in C.A. PLEXMAN, Ed. Forestry Newsletter. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Fall issue.
- WEIR, H.J., THOMSON, M.J., CONSTABLE, D.C. and BRODERSEN, H. 1986a. A review of important forest insect and disease problems in the Chapleau District of Ontario, 1950-1980. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 33. 103 p. + appendices.
- WEIR, H.J., THOMSON, M.J., CONSTABLE, D.C. and BRODERSEN, H. 1986b. A review of important forest insect and disease problems in the Kirkland Lake District of Ontario, 1950-1980. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 34. 138 p. + appendices.
- WEIR, H.J., THOMSON, M.J., CONSTABLE, D.C. and BRODERSEN, H. 1986c. A review of important forest insect and disease problems in the Kapuskasing District of Ontario, 1950-1980. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 35. 94 p. + appendices.
- WEIR, H.J., THOMSON, M.J., CONSTABLE, D.C. and BRODERSEN, H. 1986d. A review of important forest insect and disease problems in the Kapuskasing District of Ontario, 1950-1980. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 35. 94 p. + appendices.
- WEIR, H.J., THOMSON, M.J., CONSTABLE, D.C. and JONES, C.G. 1985. A review of important forest insect and disease problems in the Temagami District of Ontario, 1950-1980. Dep. Environ., Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 27. 141 p. + appendices.
- WHITNEY, R.D. 1986. Forest pathology research--root rot of trees. p. 7-9 in C.A. PLEXMAN, Ed. Forestry Newsletter. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Spring issue.
- G.M. WICKWARE, and W.C. Stevens, *Cochairmen*. 1985. Site classification in relation to forest management. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. COJFRC Symp. Proc. O-P-14. 142 p.

- WILTSHIRE, W. 1986. Canada-Ontario Forest Resource Development Agreement update. p. 4-6 in C.A. PLEXMAN, Ed. Forestry Newsletter. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Winter issue.
- WOOD, J.E. and von ALTHEN, F.W. 1986. Cooperative herbicide trial. p. 9-10 in C.A. PLEXMAN, Ed. Forestry Newsletter. Gov't of Can., Can. For. Serv., Sault Ste. Marie, Ont. Fall issue.